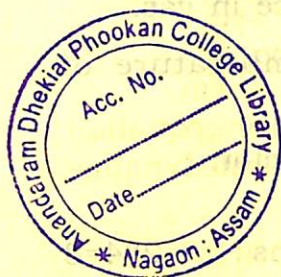


Total number of printed pages-4



3 (Sem-3/CBCS) PHY HC 2

2024

**PHYSICS**

(Honours)

Paper : PHY-HC-3026

**(Thermal Physics)**

Full Marks : 60

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

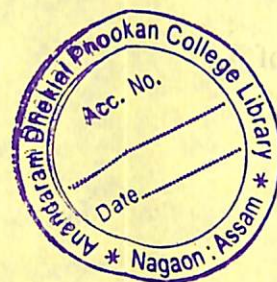
1. Answer the following questions :  $1 \times 7 = 7$
- (a) What is a cyclic process ?
  - (b) Is coefficient of performance of a refrigerator a constant quantity ?
  - (c) What is the importance of Clausius inequality in thermodynamics ?
  - (d) What is the entropy value of a perfect crystalline solid at absolute zero temperature ?

Contd.

- (e) Name the phenomenon where transport of momentum takes place in gas.
- (f) What do mean by temperature of inversion?
- (g) Define compressibility factor.

2. Answer the following questions :  $2 \times 4 = 8$

- (a) Why is  $C_P$  greater than  $C_V$ ? Explain.
- (b) What is the basic difference between reversible and irreversible processes?
- (c) What is the effect of temperature and pressure on mean free path?
- (d) How does velocity distribution curve depend on temperature?



3. Answer **any three** of the following questions:  $5 \times 3 = 15$

- (a) Derive an expression for work done during an isothermal process.
- (b) The melting point of solid tin is  $232^\circ\text{C}$ . The specific heat of solid tin is  $0.055 \text{ cal/gm}^\circ\text{K}$  and molten tin is  $0.064 \text{ cal/gm}^\circ\text{K}$ . Calculate the change in entropy when one gm of solid tin is heated from  $147^\circ\text{C}$  to  $310^\circ\text{C}$ . (Given,  $L = 15 \text{ cal/gm}$ ).

- (c) Calculate the average speed and the most probable speed of 1 mole of hydrogen molecule at  $300 \text{ K}$ . Neglect mass of electron.

$K_B$  = Boltzmann constant =  $1.380649 \times 10^{-23} \text{ joule per kelvin (K)}$ .  
 $2\frac{1}{2} + 2\frac{1}{2} = 5$

- (d) For  $6.75 \text{ mol}$  of  $\text{N}_2$  gas in a volume of 1 litre at  $150 \text{ K}$ , calculate the pressure exerted by  $\text{N}_2$  using (i) ideal gas law (ii) Van der Waals equation and (iii) Compressibility factor.

Given  $a = 1.39 \text{ atm L}^2/\text{mol}^2$

$b = 0.03913 \text{ L/mol}$

$R = 0.0821 \text{ Latm/mol K}$

$1 + 2 + 2 = 5$

- (e) Show that in an isothermal expansion of a Van der Waals' gas, the heat taken

in is  $Q = RT \log \left( \frac{V_f - b}{V_i - b} \right)$  where  $V_f$  and  $V_i$  are the final and initial volume respectively.

4. Answer **any three** of the following questions:  $10 \times 3 = 30$

- (a) Explain Carnot's cycle. Calculate the work done in the cycle of operation and hence find the efficiency of a Carnot engine.

- (b) Show that the change of entropy of one mole of a perfect gas is given by

$$\Delta S = C_V \log_e \frac{P_2}{P_1} + C_P \log_e \frac{V_2}{V_1}$$

- (c) Deduce Clausius Clapeyron equation from Maxwell's second thermodynamic relation.

- (d) Derive Maxwell's velocity distribution function.

- (e) Derive an expression of coefficient of viscosity using kinetic theory.

- (f) Deduce Van der Waals equation.

